

SUPPORT FOR THE AMENDMENTS

The present amendment amends claim 6, and adds new claims 25-28.

Claim 6 has been amended to place this claim in a better condition for allowance. Support for this amendment is provided by the originally filed claims and specification.

Support for newly added claims 25-28 is found at specification page 12, lines 1-10, page 24, lines 16-25, page 25, lines 1-17, page 26, lines 3-17, as well as original claims 3, 6, 7 and 11.

It is believed that these amendments have not resulted in the introduction of new matter.

REMARKS

Claims 1-19 and 21-28 are currently pending in the present application. Claim 6 has been amended, and new claims 25-28 have been added, by the present amendment.

Applicants wish to extend their appreciation to Examiner Yang for withdrawing the rejection of claim 23 under 35 U.S.C. § 102(b) as being anticipated over Higashi (U.S. Patent 6,617,051).

The rejections under 35 U.S.C. § 103(a) of: (1) claims 1-6, 8-10, 12, 14-19 and 21-24 as being obvious over Higashi (U.S. Patent 6,617,051) in view of Begley (U.S. 2005/0095453); and (2) claims 7, 11 and 13 as being obvious over Higashi in view of Begley and Hu (U.S. Patent 6,479,172), are respectfully traversed with respect to claims 1-19 and 21-28.

Higashi, Begley and Hu, when considered alone or in combination, fail to render obvious to a skilled artisan the organic electroluminescent device of the present invention comprising a *phosphorescent* light-emitting layer, wherein the total of halogen element mass concentrations of *bromine, iodine and chlorine* which are contained as impurities in the *phosphorescent* light-emitting layer is *50 ppm or less* (as claimed in claim 1), wherein the total of halogen element mass concentrations of *bromine and iodine* which are contained as impurities in the *phosphorescent* light-emitting layer is *40 ppm or less* (as claimed in claim 2), and wherein a halogen element mass concentration of *bromine* which is contained as an impurity in the *phosphorescent* light-emitting layer is *30 ppm or less* (as claimed in claim 3).

Assuming *arguendo* that sufficient motivation and guidance is considered to have been provided by Higashi, Begley and/or Hu to direct a skilled to arrive at the organic electroluminescent device of the present invention, which is clearly not the case, such a case of obviousness is rebutted by a showing of unexpected results.

Claim 1 recites an organic electroluminescent device in which an organic thin film layer comprising a single layer or plural layers comprising a *phosphorescent* light-emitting layer comprising at least a host material and a phosphorescent organic metal complex is interposed between a cathode

and an anode, wherein the *total of halogen element mass concentrations of bromine, iodine and chlorine which are contained as impurities in the host material of the phosphorescent light-emitting layer is 50 ppm or less.*

Claim 2 recites an organic electroluminescent device in which an organic thin film layer comprising a single layer or plural layers comprising a *phosphorescent* light-emitting layer comprising at least a host material and a phosphorescent organic metal complex is interposed between a cathode and an anode, wherein the *total of halogen element mass concentrations of bromine and iodine which are contained as impurities in the host material of the phosphorescent light-emitting layer is 40 ppm or less.*

Claim 3 recites an organic electroluminescent device in which an organic thin film layer comprising a single layer or plural layers comprising a *phosphorescent* light-emitting layer comprising at least a host material and a phosphorescent organic metal complex is interposed between a cathode and an anode, wherein a *halogen element mass concentration of bromine which is contained as an impurity in the host material of the phosphorescent light-emitting layer is 30 ppm or less.*

Higashi describes an organic electroluminescent device comprising an organic compound layer comprising an organic emitting layer sandwiched between a pair of electrodes, wherein the organic compound layer comprises an organic compound material having a *halogen-containing compound* impurity concentration of *lower than 1,000 ppm, including lower than 500 ppm and 0 ppm*, and wherein the organic emitting layer comprises a host light-emitting material and a *fluorescent dopant* (e.g., DPAVBi) (See e.g., abstract, column 2, lines 1-32, column 3, lines 6-15, column 22, lines 36-45, column 32, lines 39-49, column 36, lines 1-18, column 41, Table 2 and lines 26-30, column 43, lines 15-21, claims 9, 10 and 15-18).

Higashi fails to describe or exemplify an organic electroluminescent device comprising a *phosphorescent* light-emitting layer, wherein the total of *halogen element mass concentrations of bromine, iodine and chlorine* which are contained as impurities in the *phosphorescent* light-emitting

layer is *50 ppm or less* (as claimed in claim 1), wherein the total of *halogen element* mass concentrations of *bromine and iodine* which are contained as impurities in the *phosphorescent* light-emitting layer is *40 ppm or less* (as claimed in claim 2), and wherein a *halogen element* mass concentration of *bromine* which is contained as an impurity in the *phosphorescent* light-emitting layer is *30 ppm or less* (as claimed in claim 3). As a result, Higashi fails to render obvious to a skilled artisan the organic electroluminescent device of the present invention.

A prima facie case of unpatentability requires that the cited reference be enabling by providing a skilled artisan with a known or obvious process for producing the claimed compound. See e.g., MPEP § 2145 and *In re Hoeksema*, 158 USPQ 596, 601 (CCPA 1968). A cited reference must enable one of ordinary skill in the art to make the claimed invention without undue experimentation. See e.g., *Impax Laboratories v. Aventis Pharmaceuticals Inc.*, 88 USPQ2d 1381, 1383, 1384 (Fed. Cir. 2008). The mere naming of a compound in a cited reference, without more (i.e., a disclosure in the cited reference enabling a skilled artisan to actually make the claimed compound without undue experimentation), cannot constitute a description of the compound, particularly when, as in this case, the evidence of record suggests that a method suitable for its preparation was not developed until a date later than that of the reference. See e.g., *In re Wiggins*, 179 USPQ 421, 425 (CCPA 1973).

Higashi fails to exemplify that any method described therein actually produces an organic electroluminescent device comprising a phosphorescent light-emitting layer, wherein the total of bromine, iodine and chlorine impurities is 50 ppm or less (as claimed in claim 1), wherein the total bromine and iodine impurities is 40 ppm or less (as claimed in claim 2), and wherein the bromine impurity is 30 ppm or less (as claimed in claim 3).

Applicants submit that *because Higashi fails to disclose or render obvious to a skilled artisan a method for producing a phosphorescent light-emitting layer possessing the halogen impurity concentrations recited in claims 1-3, undue experimentation would therefore necessarily be required for a skilled artisan to make the same based on the limited and non-enabling disclosure of Higashi.*

As a result, *it cannot be legally concluded that Higashi has placed in possession of the public a phosphorescent light-emitting layer possessing the halogen impurity concentrations recited in claims 1-3, thereby precluding a prima facie case of unpatentability of the claimed invention.*

Begley and Hu fail to compensate for the above-mentioned deficiencies of Higashi, thereby precluding a *prima facie* case of obviousness.

Begley describes an organic electroluminescent device comprising a light-emitting layer comprising a host material and a dopant, wherein the dopant is *usually a fluorescent dye* (See e.g., [0114]-[0115]). Begley *merely mentions* that a phosphorescent dopant *may* also be used in the light-emitting layer (See e.g., [0115]). Begley fails to provide a skilled artisan with sufficient motivation and guidance to particularly select the briefly mentioned phosphorescent dopants rather than the fluorescent dopants typically used by skilled artisans according to Begley, or the *particularly preferred fluorescent rubrene dopants*, described and exemplified therein (See e.g., [0049], [0051], [0153], [0169]). Accordingly, a skilled artisan would not have been motivated to particularly select the *phosphorescent dopant* briefly mentioned in Begley over the *particularly preferred fluorescent rubrene dopants* described and exemplified therein, for incorporation into the organic emitting layer of Higashi comprising a host light-emitting material and a *fluorescent dopant*, absent impermissible hindsight reconstruction, thereby precluding a *prima facie* case of obviousness. Unlike the claimed invention, Begley is *completely silent* as to the *concentration of halogen impurities* present in the *phosphorescent* light-emitting layer. Therefore, Begley clearly fails to compensate for the above-mentioned deficiencies of Higashi.

Hu describes an organic electroluminescent device comprising an electroluminescent element positioned between an anode and a cathode, wherein the electroluminescent element comprises a *fluorescent* light-emitting layer comprising a host fluorescent hydrocarbon compound and a fluorescent dye (See e.g., abstract, column 2, lines 16-20, column 3, lines 54-60, column 9, lines 16-20, column 11, lines 65-67, column 12, lines 1-3, column 19, lines 64-66, column 20, lines 64-65,

column 61, lines 28-31, claim 5). Unlike the claimed invention, Hu is *completely silent* as to a *phosphorescent* light-emitting layer or *concentrations of halogen impurities* contained therein.

Therefore, Hu also clearly fails to compensate for the above-mentioned deficiencies of Higashi.

As a result, Higashi, Begley and Hu, when considered alone or in combination, clearly fail to provide sufficient motivation and guidance to enable a skilled artisan to arrive at the organic electroluminescent device of the present invention comprising a *phosphorescent* light-emitting layer, wherein the total of *halogen element* mass concentrations of *bromine, iodine and chlorine* which are contained as impurities in the *phosphorescent* light-emitting layer is *50 ppm or less* (as claimed in claim 1), wherein the total of *halogen element* mass concentrations of *bromine and iodine* which are contained as impurities in the *phosphorescent* light-emitting layer is *40 ppm or less* (as claimed in claim 2), and wherein a *halogen element* mass concentration of *bromine* which is contained as an impurity in the *phosphorescent* light-emitting layer is *30 ppm or less* (as claimed in claim 3).

Assuming *arguendo* that sufficient motivation and guidance, as well as an enabling disclosure, is considered to have been provided by Higashi, Begley and/or Hu to direct a skilled to arrive at the organic electroluminescent device of the present invention, which is clearly not the case, such a case of obviousness is rebutted by a showing of unexpected results.

As discussed in the present specification and shown by the comparative experimental data presented therein, Applicants have discovered that an organic electroluminescent device, which comprises a purified (refined) *phosphorescent* light-emitting layer having a total of *halogen element* mass concentrations of *bromine, iodine and chlorine* reduced to an amount of *50 ppm or less* in accordance with the present invention, surprisingly exhibits a remarkable degree of improvement with respect to drastically enhanced performance and prolonged half lifetime, as compared to the inferior properties of decreased performance and shortened half lifetime exhibited by a traditional organic electroluminescent device, which comprises a conventional unpurified (unrefined) *phosphorescent*

light-emitting layer having a total of halogen element mass concentrations of *bromine, iodine and chlorine* present in an amount outside the claimed range of *50 ppm or less*

As shown in Table 2 of Higashi, the organic electroluminescent device of Examples 1, 3 and 4 comprising a purified (sublimed) *fluorescent* light-emitting material exhibited a general improvement in prolonged half lifetime of 7000, 6000 and 4000 hours, respectively, as compared to the shortened half lifetime of 5000, 3000 and 3500 hours, respectively, exhibited by the organic electroluminescent device of Examples 2, 7 and 6 comprising an unpurified (impure) *fluorescent* light-emitting material. This represents marginally enhancing performance and prolonging half lifetime by a factor of only 1.4, 2.0 and 1.1, respectively.

The Examiner alleged in the Advisory Action dated May 24, 2010 that Applicant's comparison of lifetime data with that of Higashi is not applicable since differences exist between the two devices including that the device as disclosed in Higashi is a *fluorescent* organic electroluminescent device and because impurity concentrations are not specified. Applicants submit that if the comparison of the present invention with the disclosure of Higashi is not applicable because of the differences that exist therebetween, as alleged by the Examiner, then Higashi should clearly not be cited as a prior art reference against the above-identified application.

As shown in the Table below, which compiles into tabular form comparative experimental data presented in the present specification, the inventive organic electroluminescent device 2, 4, 5-7 and 10 of Examples 1, 2, 3-5 and 6, respectively, comprising a purified (refined) *phosphorescent* light-emitting layer having a total of *halogen element* mass concentrations of *bromine, iodine and chlorine* present in an amount of *50 ppm or less* in accordance with the present invention *surprisingly* exhibited an *unexpectedly* prolonged half lifetime of 467, 71, 1083, 3988, 4623 and 2469 hours, respectively, as compared to the inferior shortened half lifetime of 70, 0.7, 57 and 475 hours exhibited by the organic electroluminescent device 1, 3, 8 and 9 of Comparative Examples 1, 2, 3 and 4, respectively, comprising an unpurified (unrefined) *phosphorescent* light-emitting layer having a total of halogen

element mass concentrations of *bromine, iodine and chlorine* present in an amount outside the claimed range of *50 ppm or less* (See e.g., page 13, lines 10-15, page 60, lines 4-25, page 61, lines 1-9, page 63, last paragraph, page 68, last two paragraphs, page 69, lines 1-21, page 72, lines 2-13, page 76 in its entirety, page 77, lines 1-22, page 78, lines 1-14, page 80, lines 13-16 and 21-24, page 81, lines 1-9, Figs. 1, 3, 4 and 6). This represents *drastically* enhancing performance and prolonging half lifetime by a factor of 6.7, 101, 19, 70, 81 and 5.2, respectively.

Device	Example	Half Lifetime (Hours)	Factor
1	Comp. Ex. 1	70	
2	Ex. 1	467	6.7
3	Comp. Ex. 2	0.7	
4	Ex. 2	71	101
5	Ex. 3	1083	19
6	Ex. 4	3988	70
7	Ex. 5	4623	81
8	Comp. Ex. 3	57	
9	Comp. Ex. 4	475	
10	Ex. 6	2469	5.2

Applicants submit that an organic electroluminescent device comprising a purified (refined) *phosphorescent* light-emitting layer having a total of *halogen element* mass concentrations of *bromine, iodine and chlorine* present in an amount of *50 ppm or less* in accordance with the present invention surprisingly exhibited a *drastically* enhanced performance and an *unexpectedly* prolonged half lifetime far beyond that which may have been reasonably expected by the combined disclosures of the cited references, especially in light of the negligible or general improvement in properties with respect to marginally enhanced performance and slightly prolonged half lifetime exhibited by the organic electroluminescent devices described and exemplified in Higashi.

Higashi describes that an organic compound material purified through sublimation has a reduced concentration of halogen containing *compound* impurities (e.g., lower than 1,000 ppm as

determined through high-performance liquid chromatography analysis) (See e.g., column 2, lines 8-55). Based on the disclosure of Higashi, a skilled artisan would reasonably conclude that an organic electroluminescent device comprising an organic compound layer comprising a *fluorescent dopant* and an organic compound material having a *halogen-containing compound* impurity concentration of *slightly less than 1,000 ppm, including slightly less than 500 ppm*, would be an acceptable amount of halogen-containing impurity.

In contrast, the present invention is based on a remarkable finding that when a *phosphorescent* organic metal complex is used as a dopant together with a host material having a concentration of *50 ppm or lower* of *halogen element* impurities (e.g., Br, I and Cl as *atoms*), the *lifetime* of the organic electroluminescent device can *surprisingly* be extended by a *factor of more than 5 times* that which is exhibited by a conventional organic electroluminescent device comprising a phosphorescent organic metal complex that is used as a dopant together with a host material having a concentration of halogen element impurities exceeding 50 ppm.

Applicants respectfully submit that contrary to page 9 of the Official Action, the cited references, when considered alone or in combination, fail to disclose or reasonably suggest to a skilled artisan that a such a *remarkable degree* of improvement with respect to extending the lifetime of the organic electroluminescent device by a *surprising factor of more than 5 times* would be achieved by reducing *halogen element* impurities to a concentration of *50 ppm or lower*. Such a remarkable degree of improvement would not be expected based on the disclosures of the cited references.

Applicants wish to direct the Examiner's attention to Example 6 and Comparative Example 4. Example 6 has a halogen element impurity concentration of 32 ppm and exhibits a drastically increased half lifetime of 2469 hours. In contrast, Comparative Example 4 has a halogen element impurity concentration of 104 ppm and exhibits an inferior half lifetime of only 475 hours. The same compounds are used in Example 6 and Comparative Example 4 with the exception of having a different concentration of halogen element impurities contained therein.

Based on the limited disclosures of the cited references, one of ordinary skill in the art could not have reasonably predicted that the lifetime of the organic electroluminescent device could be drastically improved by a surprising factor of at least 5 by limiting the concentration of halogen element impurities to an amount of *50 ppm or less*, as presently claimed.

Higashi fails to disclose or suggest that a drastic improvement in lifetime by a factor of at least 5 is achieved by reducing the concentration of halogen element impurities to an amount of *50 ppm or less* via purification of the compound described therein by sublimation or otherwise. Since Begley is completely silent as to the concentration of halogen element impurities, Begley necessarily fails to recognize improving the lifetime by a factor of at least 5 by decreasing the concentration of halogen element impurities to a concentration of 50 ppm or less, in accordance with an exemplary aspect of the present invention.

Higashi also fails to disclose or suggest utilizing a phosphorescent organic metal complex. Although Begley briefly mentions that phosphorescent compounds may be useful as a dopant, Begley explicitly states that dopants are usually selected from fluorescent dyes. Begley fails to provide a skilled artisan with sufficient motivation and guidance to particularly select the phosphorescent dopant from the among the preferred fluorescent dopants, and the *particularly preferred fluorescent rubrene dopants*, described and exemplified therein (See e.g., [0049], [0051], [0153], [0169]). Why would a skilled artisan be motivated to substitute the phosphorescent dopant briefly mentioned in Begley for the fluorescent dopant of Higashi, especially when both Begley and Higashi describe and exemplify the use of fluorescent dopants as particularly preferred dopants? Accordingly, a skilled artisan would not have been motivated to particularly select the *phosphorescent dopant* briefly mentioned in Begley over the *particularly preferred fluorescent rubrene dopants* described and exemplified therein, for incorporation into the organic emitting layer of Higashi comprising a host light-emitting material and a *fluorescent dopant*, absent impermissible hindsight reconstruction, thereby precluding a *prima facie* case of obviousness.

Withdrawal of these grounds of rejections is respectfully requested.

In conclusion, Applicants submit that the present application is now in condition for allowance and notification to this effect is earnestly solicited.

Respectfully submitted,

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